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PLANETARY PHENOMENA FOR MAY AND JUNE, 1898.

By Professor Malcolm McNeill.

May.

Mercury passes inferior conjunction and becomes a morning star on the morning of May 1st. It moves rapidly away from the Sun, but toward a more southern position, so that, although its greatest elongation of twenty-four degrees, which it reaches on May 28th, is above the average, its southern position makes it difficult to see. It may possibly be seen for a few days at the close of the month near the eastern horizon in the morning twilight.

Venus is an evening star, gradually increasing its distance from the Sun, setting about two hours later at the close of the month. It moves nearly forty degrees eastward during the month, through the constellation *Taurus* into *Gemini* (See Map III), passing μ *Geminorum* just before the close of the month.

Mars is a morning star, rising somewhat earlier than during April. It is growing a little brighter, but has not increased very much as yet. It moves twenty-one degrees east and nine degrees north during the month, in the constellation *Pisces*. There are no bright stars in the constellation, but it is on Map I, between *Pegasus* and *Cetus*.

Jupiter is in good position for observation all through the evening until after midnight, and may be found on Map III, a little east of η *Virginis*. It moves about one degree westward until May 27th, and then moves eastward.

Saturn is getting into better position for evening observation, rising a little before sunset at the close of the month. It may be found on Map IV, about six degrees north and a little east of α *Scorpii*. It moves about two degrees westward during the month. It is in opposition with the Sun on the morning of May 30th. The ratio of apparent axes of the rings is about 23/100.

Uranus is near *Saturn*, and may be found on the same Map IV, about eight degrees west of that planet. It moves a little more than one degree westward, and early in the month passes β *Scorpii*, less than one degree to the south of the star.

Neptune is an evening star, in the constellation *Taurus*, Map III. *Venus* passes two degrees to the north of it on May 19th.

JUNE.

The Sun reaches its greatest northern declination, and summer begins on June 21st, 2 A.M., Pacific time.

Mercury is a morning star until June 30th, when it passes superior conjunction. During the first ten days of the month it rises about an hour before sunrise, and may possibly be seen under favorable atmospheric conditions, but it is not in very good position for observation.

Venus increases its distance from the Sun about seven degrees during the month, but as its motion in declination is southward, its setting time remains about two hours after sunset throughout the month. It moves thirty-eight degrees east and six degrees south, through the constellations *Gemini* and *Cancer*, into the western part of *Leo*, passing about five degrees south of *β Geminorum* a little before the middle of the month (Map III).

Mars rises about an hour earlier than during the corresponding part of April. It moves twenty-one degrees east and seven degrees north, through the constellations *Pisces* and *Aries*, and may be found on Map I. It passes several degrees south of the stars in *Aries*, which are marked on the map.

Jupiter is still in good position for evening observation, as it does not set before midnight until nearly the close of the month. It may be found on Maps II or III, in the constellation *Virgo*, not far from *η Virginis*, and at the end of the month it is only about one degree west and north of the star. It has moved a little eastward and southward during the month.

Saturn passed opposition with the Sun at the end of May, and is above the horizon nearly the entire night. It moves about two degrees westward, in the constellation *Scorpio* (see Map IV), and is about seven degrees north of *α Scorpii.*

Uranus is near *Saturn*, about eight degrees west, on the same Map IV. It moves about one degree westward, and at the close of the month it is about two degrees westward and $0^\circ.5$ south of the star *β Scorpii.*

Neptune is close to the Sun throughout the month, and is in conjunction with it on June 12th.

Occultation. The Moon approaches very close to the first-magnitude star *α Scorpii* on the evening of June 3d, and there may be an occultation of the star for places in the northern part of the United States.

EXPLANATION OF THE TABLES.

The phases of the Moon are given in Pacific Standard time. In the tables for Sun and planets, the second and third columns give the Right Ascension and Declination for Greenwich noon. The fifth column gives the local mean time for transit over the Greenwich meridian. To find the local mean time of transit for any other meridian, the time given in the table must be corrected by adding or subtracting the change per day, multiplied by the fraction whose numerator is the longitude from Greenwich in hours, and whose denominator is 24. This correction is seldom much more than 1^m. To find the standard time for the phenomenon, correct the local mean time by *adding* the difference between standard and local time if the place is west of the standard meridian, and *subtracting* if east. The same rules apply to the fourth and sixth columns, which give the local mean times of rising and setting for the meridian of Greenwich. They are roughly computed for Lat. 40°, with the noon Declination and time of meridian transit, and are intended as only a rough guide. They may be in error by a minute or two for the given latitude, and for latitudes differing much from 40° they may be several minutes out.

PHASES OF THE MOON, P. S. T.

		H. M.
Full Moon,	May 5,	10 34 P. M.
Last Quarter,	May 12,	1 36 P. M.
New Moon,	May 20,	4 58 A. M.
First Quarter,	May 28,	9 14 A. M.

THE SUN.

1898.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
May 1.	2 35	+15 10	5 4 A.M.	11 57 A.M.	6 50 P.M.
11.	3 13	+17 58	4 53	11 56	6 59
21.	3 53	+20 15	4 44	11 56	7 8
31.	4 33	+21 58	4 38	11 57	7 16
			MERCURY.		
May 1.	2 34	+15 41	5 1 A.M.	11 56 A.M.	6 51 P.M.
11.	2 18	+11 31	4 20	11 0	5 40
21.	2 25	+10 42	3 52	10 29	5 6
31.	2 57	+13 20	3 35	10 21	5 7
			VENUS.		
May 1.	3 50	+20 24	5 59 A.M.	1 12 P.M.	8 25 P.M.
11.	4 42	+22 57	6 2	1 25	8 48
21.	5 35	+24 25	6 8	1 38	9 8
31.	6 28	+24 44	6 21	1 52	9 23

Mars.

1898.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
May 1.	0 9	− 0 18	3 33 A.M.	9 32 A.M.	3 31 P.M.
11.	0 38	+ 2 45	3 12	9 21	3 30
21.	1 6	+ 5 44	2 50	9 9	3 28
31.	1 34	+ 8 36	2 29	8 58	3 27
			Jupiter.		
May 1.	12 7	+ 0 52	3 25 P.M.	9 28 P.M.	3 31 A.M.
11.	12 5	+ 1 5	2 43	8 46	2 49
21.	12 4	+ 1 11	2 2	8 6	2 10
31.	12 4	+ 1 10	1 22	7 26	1 30
			Saturn.		
May 1.	16 39	− 20 12	9 15 P.M.	2 3 A.M.	6 51 A.M.
11.	16 36	− 20 6	8 32	1 21	6 10
21.	16 33	− 20 0	7 50	12 39	5 28
31.	16 30	− 19 54	7 3	11 52 P.M.	4 41
			Uranus.		
May 1.	16 1	− 20 29	8 38 P.M.	1 25 A.M.	6 12 A.M.
11.	15 59	− 20 24	7 57	12 44	5 31
21.	15 58	− 20 20	7 15	12 3	4 51
31.	15 56	− 20 14	6 30	11 18 P.M.	4 6
			Neptune.		
May 1.	5 20	+ 21 50	7 24 A.M.	2 42 P.M.	10 0 P.M.
11.	5 21	+ 21 51	6 46	2 4	9 22
21.	5 23	+ 21 53	6 8	1 26	8 44
31.	5 24	+ 21 55	5 30	12 48	8 6

ECLIPSES OF *JUPITER'S* SATELLITES, P. S. T.

(Off right-hand limb, as seen in an inverting telescope.)

			H. M.				H. M.
I, R,	May	1.	9 4 P. M.	I, R,	May	17.	7 21 P. M.
II, R,		3.	9 1 P. M.	II, R,		18.	2 14 A. M.
I, R,		8.	10 58 P. M.	III, D,		23.	9 43 P. M.
I, R,		10.	5 27 P. M.	III, R,		24.	12 9 A. M.
II, R,		10.	11 37 P. M.	I, R,		24.	9 16 P. M.
I, R,		16.	12 52 A. M.	II, R,		28.	6 9 P. M.
III, D,		16.	5 44 P. M.	III, D,		31.	1 42 A. M.
III, R,		16.	8 12 P. M.	I, R,		31.	11 10 P. M.

PHASES OF THE MOON, P. S. T.

		H. M.
Full Moon,	June 4,	6 11 A. M.
Last Quarter,	June 10,	10 4 P. M.
New Moon,	June 18,	8 19 P. M.
First Quarter,	June 26,	8 54 P. M.

THE SUN.

1898.	R. A.	Declination.	Rises.	Transits.	Sets.
	H. M.	° ′	H. M.	H. M.	H. M.
June 1.	4 38	+ 22 6	4 39 A.M.	11 58 A.M.	7 17 P.M.
11.	5 19	+ 23 7	4 35	11 59	7 23
21.	6 0	+ 23 27	4 37	12 2 P.M.	7 27
July 1.	6 42	+ 23 6	4 40	12 4	7 28
			MERCURY.		
June 1.	3 1	+ 13 44	3 34 A.M.	10 21 A.M.	5 8 P.M.
11.	3 57	+ 18 26	3 32	10 37	5 42
21.	5 15	+ 22 56	3 53	11 16	6 39
July 1.	6 49	+ 24 24	4 40	12 10 P.M.	7 40
			VENUS.		
June 1.	6 33	+ 24 42	6 22 A.M.	1 53 P.M.	9 24 P.M.
11.	7 26	+ 23 42	6 41	2 7	9 33
21.	8 17	+ 21 35	7 1	2 18	9 35
July 1.	9 6	+ 18 30	7 23	2 28	9 33
			MARS.		
June 1.	1 37	+ 8 53	2 26 A.M.	8 57 A.M.	3 28 P.M.
11.	2 5	+ 11 34	2 5	8 45	3 25
21.	2 33	+ 14 2	1 46	8 34	3 22
July 1.	3 2	+ 16 16	1 26	8 23	3 20
			JUPITER.		
June 1.	12 4	+ 1 9	1 18 P.M.	7 22 P.M.	1 26 A.M.
11.	12 5	+ 1 0	12 41	6 44	12 47
21.	12 7	+ 0 44	12 5	6 7	12 9
July 1.	12 10	+ 0 21	11 30 A.M.	5 31	11 32
			SATURN.		
June 1.	16 30	− 19 54	6 59 P.M.	11 48 P.M.	4 37 A.M.
11.	16 27	− 19 48	6 15	11 5	3 55
21.	16 24	− 19 42	5 33	10 23	3 13
July 1.	16 21	− 19 38	4 50	9 41	2 32
			URANUS.		
June 1.	15 56	− 20 14	6 26 P.M.	11 14 P.M.	4 2 A.M.
11.	15 55	− 20 9	5 44	10 33	3 22
21.	15 53	− 20 5	5 3	9 52	2 41
July 1.	15 52	− 20 1	4 23	9 12	2 1
			NEPTUNE.		
June 1.	5 25	+ 21 55	5 25 A.M.	12 44 P.M.	8 3 P.M.
11.	5 26	+ 21 56	4 47	12 6	7 25
21.	5 28	+ 21 58	4 10	11 29 A.M.	6 48
July 1.	5 29	+ 21 59	3 32	10 51	6 10

ECLIPSES OF *JUPITER'S* SATELLITES, P. S. T.

(Off right-hand limb, as seen in an inverting telescope.)

		H. M.			H. M.
I, R,	June 2.	6 39 P. M.	II, D,	June 18.	11 33 P. M.
II, R,	4.	8 45 P. M.	I, R,	23.	11 23 P. M.
I, R,	8.	1 5 A. M.	I, R,	25.	5 52 P. M.
I, R,	9.	7 34 P. M.	III, D,	28.	5 41 P. M.
II, D,	11.	8 56 P. M.	III, R,	28.	8 1 P. M.
II, R,	11.	11 22 P. M.	II, R,	29.	5 51 P. M.
I, R,	16.	9 29 P. M.			

LIST OF EARTHQUAKES IN CALIFORNIA FOR THE YEAR 1897.

COMPILED BY C. D. PERRINE.

The following list is a continuation of similar reports printed in these *Publications:* Vol. II, p. 74; Vol. III, p. 247; Vol. V, p. 127; Vol. VI, p. 41; Vol. VII, p. 99; Vol. VIII, p. 222, and Vol. IX, p. 37. A more complete account will be published by the Unites States Geological Survey as a bulletin. The dates are civil dates. The times are Pacific Standard (120th meridian).

Roman numerals enclosed in parentheses indicate the intensity on the ROSSI-FOREL scale.

Some doubtful cases have been included, and are indicated either by a note or by an interrogation point enclosed in parentheses.

In 1897 there were twenty-five shocks of earthquake recorded in California as against sixteen for the year 1896.

The shock of June 20th was accurately timed at Mt. Hamilton and Oakland, and as we know approximately the center from which the disturbance radiated, we can obtain the velocity over this part of its path. At Mt. Hamilton the beginning was noted at $12^h\ 12^m\ 56^s$ P.M., P. S. T., by several observers, and Mr. BABCOCK obtained $12^h\ 13^m\ 9^s$ as the time of the same phase in Oakland, an interval of thirteen seconds. Assuming the epicentrum to have been between San Juan and Salinas, we find Mt. Hamilton to be forty miles from this point, while Oakland is eighty miles. As both points lie nearly in the same direction from the origin of the disturbance, differing only twenty degrees, we may assume that the disturbance moved with the same velocity